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## Contribution to the Probable Biology of Plasomen.

By Albert Schneider.

It is only for few years that the theory of the cell-unit has been wholly exploded. Since then many valuable discoveries have been made in regard to cell structure. Brücke, Altmann, Hartig, Nägeli, Flemming, Stricker, Strassburger, Guignard, Schmitz, Berthold, Boveri, Bütchli and Wiesner are a few of the leading scientists who have made valuable contributions to cytology. We must, however, not forget workers of lesser note whose contributions in the aggregate are indeed of great value.

Scientists are now agreed that the cell, which has been heretofore considered the ultimate unit of structure, is made up of a multitude of simpler units combining to form, so to speak, cell organs, as cell wall, chromoplastids, cell granules, chromotin threads, nucleoli, etc. All efforts to show that protoplasm (cytoplasm) is a homogeneous substance with a definite arrangement have been futile. Among the recent workers, Bütchli has endeavored to show that cytoplasm always has a reticulated (wabenartige) structure. That such a structure is often noticeable is certainly true. It is likewise true that often such a structure is not noticeable. Such efforts, especially when too strongly prompted to conform to some preconcieved notion, lead to no good results, but rather create scientific distrust and confusion.

That cytoplasm is not a homogeneous substance is now generally accepted. It is supposed to be made up of a multitude of

ultimate living units of structure. Wiesner has probably formulated the most plausible theory in regard to these ultimate units which he has designated plasomen. The plasomen, like Nägeli's micellæ, have thus far only a hypothetical existence. The following is a brief summary of Wiesner's reasons for assuming the existence of plasomen.

1. The more or less constant presence of organized individuals (nucleus, plastids, etc.) in the cell teaches conclusively that the cell cannot be the ultimate unit of living structures.

2. Since all organized individuals of the cell originate from similar organized individuals, through division, it is to be supposed that all organized bodies found within the cell are not formed spontaneously but through fission.

3. Mitosis teaches that the nucleus as well as cytoplasm consists of autodivisible organic individuals. From this we are induced to conclude that the nucleus and cytoplasm are not the ultimate units of structure, but that *they* are built up of ultimate units. The origin and development of the cell wall indicates that it is also made up of ultimate units.

4. Autodivision within the cell goes beyond the limits of direct observation. A limit to the divisibility of living substance must exist. These last divisible living bodies of the cell are to be considered the ultimate units of structure (elementarorganismen). These ultimate units Wiesner designates plasomen.

5. Plasomen have above all the power to divide, and since they divide continuously up to a certain limit they must also have the power to grow; but growth necessitates assimilation; hence divisibility, growth and assimilation are preëminently the properties of plasomen.

6. Organic cell individuals (nucleus, plastids, cell wall, dermatosomen, etc.) are plasom aggregates. Cytoplasm is simply a multitude of undifferentiated plasomen.

7. Growth of cytoplasm, of cell wall, nuclei, plastids, takes place as does the growth of many-celled organisms; the latter grow as the result of cell growth and division, the former as the result of plasom division and growth.

It is not my intention to discuss or explain Wiesner's theory, but rather to give what I hold to be additional evidence as to the

correctness of his assumptions. While examining root tubercles of *Cycas revoluta* I noticed that the palisade layer cells contained many rather large cytoplasmic granules (dermatosomen, zell granula, elementarorganismen, etc.). They are highly refractive, spherical in shape, and in size varying, beginning at the limits of of observation to one half mikron ($\mu$) in diameter; a few are as much as one $\mu$ in diameter. Only the larger ones were noticeable with the objectives at my disposal (Zeiss 2.0 mm. hom. imm. ap. 140). On the addition of aqueous cor. sub. solution ($\frac{1}{1000}$ per cent.) they took on a dark stain and were brought to view very much better. It was seen that the protoplasm was made up of granules of all sizes up to the limit given. Most of the aniline dyes stain them more or less. To my knowledge nothing is superior to the above mentioned sublimate solution. In the case of *Cycas* root tubercles it seems to answer much better than Altmann's method, which consists in adding alcoholic sublimate solution followed by acid fuchsin stain. The fact that I noticed quite a number of hourglass forms led me to suppose that they underwent division, though Wiesner states that they probably have lost the power to do so. I made some culture experiments, not with the expectation of developing a culture of plasomen, but rather, if possible, to study their vitality outside of the cell. Cycad tubercles were carefully washed, then dried quickly by means of blotting paper which had been passed through the flame of a Bunsen burner; then the tubercle itself was passed through the flame so as to singe it on all sides. With a sterilized knife the dermal layer was cut down one side and the tubercle broken (not cut) across. The inoculations were then made from the green palisade layer upon various agar-veg. extract media. The inoculated tubes were then placed in a dark incubator at a constant temperature of 35° C. After from three to five days a small growth was noticed in most tubes at points of inoculation. Examination showed the presence of cocci and bacteria. Treating with aqueous sub. sol. showed also the presence of plasomen. These were introduced with the inoculating needle and became more or less intermixed with the cocci and bacteria culture. I made repeated examinations of these cultures at intervals of several days, always finding a few plasomen. After a period of three or four

weeks I was no longer able to detect any. In a few tubes there was no development of bacteria. In these I could study the plasomen unobstructed. There was no visible growth, but examination showed the unmistakable presence of the plasomen. After a time more mature plasomen (dermatosomen) were noticeable, and these mature plasomen were evidently present in greater numbers than when the inoculation was made. In about three weeks from the time of inoculation the plasomen were nearly all mature, often united into small zoögloæ. I do not intend to state that all the plasomen, visible and invisible, introduced with the inoculating needle developed to maturity, since it is impossible even to conjecture the number introduced. I was at first inclined to ignore them, thinking they were probably by-products of the bacteria and cocci. But their presence in inoculated tubes containing no bacteria, and their behavior with sublimate solution indicated that they were true Plasomen. I also made plasom cultures from developing tubers of *Solanum tuberosum* and growing roots of *Zea Mays* with similar results. In all cases there was for a time an apparent increase in the number of mature plasomen coinciding with a decrease in number of the smaller plasomen; later only mature plasomen were present, and finally these decreased in number until all had disappeared. In the case where entire cells were inoculated it was plainly noticeable that the mature plasomen increased somewhat in number until finally the cell contained only those developed to maturity. This phenomenon is also often noticeable in bacterial cells and cells of hyphal fungi found in culture media. The probably correct explanation of these phenomena is as follows: The plasomen of Wiesner have a veritable existence and are capable of developing into mature dermatosomen outside of the living cell. The plasomen can, however, not divide outside of the living cell. The reason for this latter supposition is that the dermatosomen do not continue to exist. The apparent reproduction or increase in number is due to the growth of the invisible plasomen to visible dermatosomen. As soon as all plasomen capable of growth have reached maturity apparent reproduction ceases, and the dermatosomen begin to decrease in number as they are scattered through the culture medium or become disorganized.

Cramer has observed the growth of cell walls of certain Siphonaceæ when separated from the living cytoplasm. Numerous other observations have been made to demonstrate that the cell wall of many plants is built up of living plasomen capable of considerable growth. Pfeffer and others are therefore far from right when they term the cell wall a dead substance.

The question whether cytoplasm, or to use a more correct expression, plasomen can be induced to divide outside of the living cell may be settled before very long. I believe it to be only a question of environment, and not a question of germ-plasm, as Wiesner and others seem to think.

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## Botanical Notes from Bainbridge, Georgia.

By Aug. F. Foerste.

*Rectangular Inflorescences.*—Nature is usually a graceful designer. Many flowers rather stiff and insignificant in themselves become charming from the skillful taste with which they are arranged in inflorescences. Upon a person accustomed to be alert in seeking the beauties of nature, the first sight of *Siphonychia diffusa*, Chapman, produces a queer effect, half of surprise and half of discomfort. Here is a plant with its flowers laid out in rectangular inflorescences—cymes with a flat top, with quadratic outlines, or of a form which at once makes us wish to say parallelopipedon, as though the other dimensions were equally stiff and rectangular. In these rectangles the flowers are laid off almost with the precision of corn rows in a field. This general effect is not lessened, in what seems a vain attempt of nature at grace, by the way in which these rectangular inflorescences are arranged on the stem; for, the stems being almost prostrate, all the branches being terminated by inflorescences at such heights as to bring all the inflorescences to within approximately the same plane, and the inflorescences being all disposed with their diagonals vertical or parallel to the stem, their sides all become parallel, so that the final effect is that of a series of rectangular fields, set out in some Western landscape, where all lines run north and south or east and west. In the case of this plant, we might say northeast and southwest, northwest and southeast. The fact that adjacent cymes are sometimes disposed at slightly different levels, suggests the effects of hillsides. The plant must be seen to be appreciated. It should occur in every botanical garden.

The lower branches consist of, first, two opposite leaves, bearing in the axil nearest the stem an inflorescence about half the size of the two inflorescences into which the other branches divide. The flowers usually terminate the seventh node from the main stem, all the terminal buds of the branchlets except the last being terminated by abortion at the end of each node, so that the cyme is a product of seven successive branchings of the stem.

*A curious Correllation between Sympodial Development of Branches and the Retention of Stipules in Leguminosæ.*—Two

species of *Crotallaria* were examined. In both cases the flowering peduncles representing the end of the stem are attached directly opposite the axil of a leaf, but usually a little below its level; one leafy branch arises from the axil of this leaf, and assuming the same direction as the stem apparently terminates it; another leafy branch starts from the axil of the leaf below, and is evidently axillary; four nodes intervene between successive flowering peduncles, so that the order of arrangement of the stem after it begins flowering: is two leaves usually without anything in their axils, a third leaf with a leafy branch in its axil, and a final fourth leaf with a leafy branch in its axil and the terminal flowering pedicel beyond the fourth leaf.

*C. sagittalis*, L., has long, narrow, inversely sagittate stipules, whose decurrent margins reach the node below in every case except along the first internode of each sympodial branch, which continues the leafy growth of the stem after the flowering peduncle has been thrust aside. Along this internode the decurrent margins of the stipules extend only half way down the internode, and in rare instances are confined only to the very top of this internode. These leafy continuations of the stem being in each case branches, though sympodial, of course have the first leaf of their one-half phyllotaxy in a lateral position, causing the decurrent margins of the stipules of the first internodes to be pressed by the front of the subtending leaf and the back of the flowering peduncles, and this may account for the abortion of part of its decurrent stipular growth.

*C. ovalis*, Pursh., offers in this respect a more interesting case. Here the two lower nodes show only the merest traces of stipules at the node itself. The third node at times has the stipules likewise almost obsolete, but usually the stipules are present, though of small size and decurrent for only half the length of the internode; much more rarely the stipules of this node nearly equal those of the fourth node. The fourth node always has the inversely sagittate and rather conspicuous stipules fully developed and the decurrent margins extending to the next lower node. In this case the suppression of the two lower stipules and of the lower part of the decurrent margins of the third can be less readily accounted for, and their full retention at the node preced-

ing sympodial development is interesting. The number of instances in which flowering peduncles of Leguminosæ are extra-axillary through sympodial growth is rather larger than at first suspected. The Germans call these *uebergiphelte* inflorescences. The word sympodial expresses the opposite of these relations and is therefore not a good term with which to designate such inflorescences. Some better English term, meaning *thrust aside*, should be sought, and used in the manuals of botany for the many cases where such inflorescences occur. This would be a way to advance morphological botany. Unless such a word can be found, perhaps the term *superseded inflorescences* might do.

*Cotton.*—The cotton plant is of course so well understood that nothing of botanical interest can be added to our information. Attention is only called to the fact that the inflorescences here are again morphologically terminal, *superseded* by the sympodial growth of axillary branches. The flower of the upland cotton, *Gossypium album*, Ham., is pale yellowish or greenish white early in the morning. Towards noon it becomes tinged with rose, and in the later afternoon it is of a strong rose-red color. Changes of color of plants on fading indicate possibilities as to the normal colors of flowers in the distant future, or earlier by process of selection. Nature often has solved this problem already by giving to one species a color as a normal color which another species of the genus secures only on fading. In the Sea Island cotton, *G. nigrum*, Ham., the deep rose-red color is found normally, but only as blotches at the base of the petals on the inside. It would be easy to produce cotton with rose-red flowers.

*The Practical Utilization of Phyllotaxy in Tobacco Culture.* As soon as the flower buds of tobacco begin to appear quite generally in the fields, the tops of the tobacco plants are cut off. Depending upon the vigor of the plant, the existing conditions of rain, soil, etc., the plants are topped at various heights. An expert tobacco grower will top plants at heights varying with the vigor of the individual plants. When, however, he sends a less experienced "hand" into the field, as often he must, he looks at the field as a whole, and then instructs the hand to top the tobacco at the eighth, tenth or twelfth leaf, as the case may be. The hand, of course, does not stop to count. He looks at

once for the ninth leaf, which is directly over the first, since the phyllotaxy is three-eighths. The eighth leaf is then the next one below, and the tenth the next one above, while the twelfth is directly above the space between the ninth and the tenth leaf.

In certain seasons it is found that the leaves are not going to mature equally from insufficient rain or other reasons. In that case some men remove the lower leaves nearest the ground, which are apt to ripen too fast under such circumstances. Other planters prefer to leave the lower leaves on, believing that they protect those above from dirt in case of splashing during rain. The more observant planters, however, know that the lower three leaves come beneath the spaces between the next three leaves, so that there is really no protection offered, as any one can see from the phyllotaxy, and so they cut the lower leaves off if the leaves are maturing too unequally. The planters have not studied the theoretical phyllotaxy, but they understand its practical applications.

*Renewed Growth of Trees in Summer after having already once formed their Terminal Scaly Winter Buds.*—Of course, scaly winter buds are designed by nature to protect the undeveloped tips of branches during the winter months. Moreover, the scales represent leaves, and that in a crude, undeveloped form, in what is called at times an arrested state of development, as more than necessary cases will readily demonstrate. And finally, hardly any one will deny that the presumption is in favor of a time when plants, and among them probably ligneous plants, did not possess any winter buds, but got along the best they could, freezing and hence dying back in colder climates, and more successfully bridging the non-growing season in more tropical regions. The development of winter buds must have been a gradual one, and it must have taken some time before they began the development of terminal scaly buds early enough to have made the matter very effective, and still longer before these buds were developed with the greatest economy of material and the greatest efficiency as protectors to the life within. At one time there must have been a very direct connection in time between the causes necessitating winter protection and the efforts of the plants to secure such a protection. What it is desired to especially bring under notice here is the fact that at present in ligneous plants this direct

relation, though still apparent, shows the curious anomaly of presenting the effect in early spring and the cause not until the succeeding winter. In other words, in many ligneous plants the warmth of returning spring has hardly called the vital functions of the trees again into vigorous action before the growth for the year is completed, and a few weeks later a well-developed terminal scaly bud awaits the winter. Of course, this bud itself needs considerable maturing before it will attain all the characters necessary to endure the winter's cold, and the parts the scales of the bud are intended to protect must still, in a large measure, be developed. But the fact that the more terminal leaves have remained in the crude state of scales when all the freshness of spring was inviting them on to full development to vigorous leaves can not be overlooked. Nature is thus shown to plan for the future, and, to follow this metaphor, she can be said to be prescient, taking cognizance for the future, laying in her stores at a time when they are not needed, for future use. This is true in so many ways that it cannot fail to have attracted attention. It is mentioned here to explain another set of related phenomena.

A study of the new growth of the jack oak, *Quercus nigra*, L., in spring will show that the plant has the work for the present year all planned out. The growth of the year is already practically contained in the scaly buds. Before this year's growth is fully accomplished she begins to prepare for the next year's task, and she lays out only enough work to meet the requirements. The result is that there is a certain definiteness to this work, so that it is possible in a certain measure to foretell how much the plant will do from year to year. This definiteness must bear relations to conditions of climate found in certain areas from over the plant's range of distribution. In the case of many plants these conditions seem to be found over their more northern areas of distribution. The result is that northward the relations between the requirements as to the number of leaves necessary for the vigorous development of the plant and the provisions for the same are so well cared for in the amount of growth the plant arranges for from year to year that it is rather rare to find ligneous plants renewing their growth after having once formed their terminal buds. The correlations established for more northern areas lose in value,

however, in going southward, and the result is that in the South many ligneous plants, after having already formed their terminal buds in the spring, begin to develop new growth again in the summer months, and again form terminal buds. Under exceptional conditions this may take place three or four times in the course of a year.

The black jack oak already mentioned forms a curious instance. It is very common, practically a weed on some plantations near Bainbridge. Cases of repeated renewal of growth are very common here. In the older trees growth has taken place twice during this year in the case of certain branches, each time with the formation of a terminal bud. In young sprouts coming up from the roots this renewal of growth has been quite general, common enough to present at least a few examples from any accidental point of view on the plantation. In some limited localities renewed growth has been almost general. In a case where a conflagration by destroying the growth of the present year had for a considerable time checked development, adventitious shoots have come forth, and have three times, in some cases four times, formed terminal scaly buds. It is interesting to notice how nearly equal is the number of internodes developed each time. It is a striking proof of the fact that this oak has by continual habit so developed the custom of producing a certain set of internodes and then a terminal bud, that the oak goes through this spasmodic repetition of growth and termination by winter buds, even at times when nature is favorable to a single longer continued growth, before winter buds *need* be prepared.

The dogwood, *Cornus florida*, L., may be mentioned as a similar instance, since its new growth is short and quickly formed, and composed of a fairly definite number of nodes. Some branches occasionally show evidences of two growths during one year.

The persimmon, *Diospyros Virginiana*, L., is also interesting. It is very common here as young low bushes, almost a weed, though not troublesome to the same extent as jack oaks. The number of internodes formed is much greater than in oaks, and is not so definite; only a moderate number of the nodes developed during each period of growth, being actually already indicated in the terminal bud. Still it is a good case, since cases of renewed

growth after the terminal scar had been once formed are rather frequent in some areas, and are not rare anywhere. Probably the longer season southward, with abundant moisture, has considerable to do with it.

In the case of vigorous sprouts or shoots this tendency to renewed growth is naturally emphasized, as already noticed in the case of the jack oak. New shoots from a hickory stump presented another interesting phase of the subject. On the very same stump, with sprouts all of the same age, were found a few which had made their long growth during a single uninterrupted period. In one shoot the internodes moved closer together and the leaves grew smaller towards the middlle of its length, evidently preparatory to the formation of a terminal bud; but the shoot changed its mind, and the succeding leaves became more distant and larger until, later, the real terminal bud was formed considerably farther on. In another shoot the leaves were reduced to scales towards the middle of the shoot, but the internodes were still a little too great to admit of the formation of a scaly bud at this point. While in several cases the shoots had actually developed scaly terminal buds at one time, and later these had renewed growth; and, in a single shoot, growth had taken place spasmodically at three separate intervals.

In the case of the black jack oaks which had suffered from a conflagration, and later had sent out shoots, the new branches were exceptionally vigorous. If a plant ever bears superposed buds it is almost certain to show them in such instances. The failure of these shoots to show them makes it very improbable that superposed buds ever occur in jack oaks. Instead of that was found what usually under such circumstances is the alternative, the development of two additional but lateral buds. Since no evident leaves normally subtend the two lateral buds and the scales in oak buds represent only stipules, it was difficult at first to determine whether we have here a case of lateral dedoublement or of branching from the lowest axils of the central, usually larger bud. That the latter was the case was shown, however, by the presence, in several instances, of single full developed, large leaves in a lateral position at the base of the central bud, but subtending one of these lateral buds, while everything else about the various buds was in

the form of the usual scales. In one instance the central bud had developed a single—the lowest—internode, and bore at the top of this internode, in the axil of the first scale, a small lateral bud, thus making with the two lower lateral buds a group of four scaly buds in this leaf axil.

Possibly palæobotany may some day shed light on the evolution of scaly winter buds. So far the fossil branches of dicotolydenous plants have been practically ignored. In the future they will no doubt be used to give corroborative evidence to the testimony as given by leaves alone, and we may hope for the day when the winter buds, wherever preserved, will be carefully studied.

## Dropsical Pelargoniums.*

For the past two or three years there has been an increased number of complaints made to the Experiment Station of a disease among the hot house *Pelargoniums*. Specimens received from at least a dozen places all agree in the chief essentials, while there are many variations in the details of appearance to the unassisted vision.

While the trouble is most noticeable upon the leaf blades it is by no means confined there. Upon the stem it shows itself in peculiar corky ridges which are not unfrequent upon the petioles. Upon the blades the usual appearance is that of numerous specks which seem to be supercharged with water giving to those parts a clear amber look when held up to the light. The first thought was of bacteria, there being a resemblance of the watery glands to specks found in the carnation leaves previously studied and known to be due to micro-organisms.

After making a full test for bacteria and failing to secure germs or any signs of contagion by inoculation it was concluded that the *Pelargoniums* were suffering from a dropsical affliction, and instead of the trouble being due to any parasite it seems to be entirely physiological. Photo-impressions were taken of the leaves showing different phases of the disorder.

In a green-house devoted entirely to *Pelargoniums* the trouble

* Prepared for the Botanical Club, Madison, Wisconsin, August, 1893.

may be seen upon nearly all the plants, in which case the middle aged leaves show the water-soaked appearance to best advantage. Later on moulds of the black (*Macrosponum*, sp.) or gray (*Botrytis*) sorts come in to obscure the view and hasten the destruction of the foliage. The leaves affected with the dropsy lose their healthy green color, become at first yellow only in spots or blotches, but finally so throughout.

Occasionally a plant is so afflicted that it grows but feebly, and while pushing the normal number of leaves they remain small and are badly specked before unfolding. The whole plant has a very sick and stunted appearance, and, of course, is worthless. Plants that are spotted in a less severe manner may recover after a time when removed out of doors. The dropsy seems to be the worst in early spring after the young plants are in the pots and six inches in height, bearing a dozen leaves or so.

The most frequent form of the trouble is when the translucent dots are along the veins; this being true in particular of those plants which suffer most and are dwarfed beyond their fellows. Occasionally the leaves will be only partially unfolded, and the upper border brittle and without its normal color; but as a rule the blotches and pimples are quite evenly distributed, that is, no one-half or quarter being affected to the exclusion of the other parts.

It is true that in some leaves the parts bearing the bulk of the specks are between or farthest from the veins, while in others the trouble is quite generally confined to the veins. This may be a varietal effect or possibly due to age of leaf when first afflicted. Again, sometimes the blotches are exceedingly irregular in outline and in others almost circular and quite uniform.

The reason for this unhealthy condition of the pelargoniums is most likely to be found in the circumstances under which they are being grown. Prof. Atkinson has met with a similar trouble which he calls Œdema of the Tomato and treats fully in a recent Station Bulletin. He concludes that the tumors of the tomato plant are due to the excess of water favored by insufficient light, that is, a wet soil and a soil temperature near that of the air. The long nights, short days and cloudy weather of late winter, induce the dropsical trouble, especially with a wet warm soil, thus making

root action excessive. The remedy would seem to be in providing a cooler, dryer soil, with increased light for the aerial parts, whenever possible. BYRON D. HALSTED.

## Contributions to American Bryology, III.

BY ELIZABETH G. BRITTON.

## NOTES ON THE NORTH AMERICAN SPECIES OF ORTHOTRICHUM.

### A. Those with superficial stomata.

ORTHOTRICHUM OBTUSIFOLIUM, Schrad. Crypt. Gew. 14 (1796).

Though, as its name implies, the leaves of this species are generally blunt, yet Austin collected specimens on trees in a swamp, at Jordansville, N. Y., on December 15, 1879, having the "leaves either obtuse, or acute or even apiculate on the same stem." I have verified this statement, and also observed that the perichætial leaves are occasionally even acuminate, as seen on specimens recently collected by me on the Pocono Mountain, Pennsylvania, the specimens being in fruit, and the leaves bearing the propagula and dense papillæ, which are characteristics of this species.

Although it generally grows on trees, especially poplars, and has been collected on elms along highways, and on old apple trees, yet Austin also gathered it on limestone fences, Sussex Co., N. J., and on stone walls, Herkimer Co., N. Y. These specimens are smaller and darker green than usual, for Canadian and Western specimens as well as most European ones are often light yellow with stems 1–2 cm. long. This species is probably more common in the Eastern States than is supposed, but on account of its depauperate size and frequent sterility is seldom collected.

ORTHOTRICHUM STRIATUM (L.) Hedw.

*O. leiocarpum*, Br. & Sch. Br. Eu. t. 220 (1837).

Sullivant and Lesquereux distributed this species as number 183, Musci Bor. Am., Ed. II., 1865, mixed with *O. affine*, presumably from two localities, as the label reads: Hab. in iisdem cum

praecedente (Agassiz); etiam per montes Novaeboracenses. The first locality was Lake Superior, the second locality is not cited in the Manual, and we have seen no specimens except from the one referred to above and those collected in Idaho by J. B. Leiberg; the species seems to be very rare in America. Number 183 agrees with the description given by Limpricht, and with European specimens, and is particularly noticeable for the broad, erose cilia, alternating with and nearly as broad as the teeth and often united by transverse bars.

In Austin's herbarium this species is confused with *O. speciosum*, which also has smooth capsules, but they are longer and cylindric, not ovoid, and are more exserted; the teeth are in pairs, not single, and the cilia are 8, not 16, and much narrower and tapering. An autograph specimen from T. P. James, collected at Errol Dam, N. H., is also *O. speciosum*, labelled *O. leiocarpum*, and he and Austin seem to have confused all their correspondents, for there are specimens wrongly so labelled, from Macoun, collected at five Canadian localities, from Fowler in New Brunswick, and others, all of which prove to be *O. speciosum*. Macoun's Canadian Mosses, No. 126, distributed as *O. leiocarpum* is, in our set all *O. speciosum*, as the catalogue cites it. Sullivant had the two species correctly separated, as autograph specimens sent to Dr. Torrey show, and in later years Austin corrected his mistake.

ORTHOTRICHUM AFFINE, Schrad. Spic. fl. Germ. 67 (1794).

This species is very differently treated by the three European serials,* now in course of publication, and seems to be very variable, judging by the number of varieties described and the difference in the aspect of the specimens.

It has a strongly ridged exserted capsule, with a short immersed seta, long, tapering neck, and the teeth reflexed when dry, united in pairs, (4) with eight erect cilia. But it varies from yellow to almost black, and in size from 1–5 cm.; also the capsule is either immersed or almost entirely exserted, cylindric or urceolate with a flaring mouth, and the teeth are more or less trabeculate at apex. Venturi keeps it separate from *O fas-*

*Venturi, Musc. Gall. Part VI. (1887). Braithwaite, British Mosses, Part XII. (1889). Limpricht, Laubmoose, Part XV. (1891).

*tigiatum*, Bruch; so does Limpricht, but on different characters, Venturi basing the distinction on the papillæ and upper cells of the leaves, whereas Limpricht distinguishes them by the teeth being striolate in *O. fastigiatum*, and papillose in *O. affine*. Braithwaite maintains *fastigiatum* as a variety distinguished by the smaller size and dark green color of the plants, and the urceolate capsule. It will be noted, also, that although Venturi places *affine* among the species with superficial stomata in his key, he figures it with the cells around them overlapping the guard cells. Braithwaite figures them radiating.

The stomata are described by Limpricht as being in two rows around the middle of the capsule in *O. affine*, whereas in *O. fastigiatum* they are said to be few around the base of the spore-sac. The typical form of *O. affine* is described by Venturi as having an exserted oval cylindric capsule, the plants being yellowish green and laxly pulvinate, though in the general description he says they may be yellow or dark green with capsules emergent or rarely almost immersed. Limpricht states that the cells of the leaf are thickened throughout in *O. affine*, though not in *O. fastigiatum*, and Venturi claims that the apical cells of *O. fastigiatum* are hexagonal and rounded in *O. affine*. This would agree with Limpricht's observations on the thickening of the walls.

ORTHOTRICHUM FASTIGIATUM, Bruch; Brid. Bryol. Univ. i. 795, 1826.

Sullivant and Lesquereux distributed as *O. affine*, in No. 182 of the 2d Ed. of Musci Bor. Am. two markedly different specimens, collected by Agassiz around Lake Superior, one tall and yellow with long cylindric exserted capsules, the other small and black with immersed urceolate capsules; the latter have striolate and trabeculate teeth, the former has the teeth entire, not trabeculate, and faintly striolate. Evidently then we have the same problem here as they have in Europe, only our material is so scant that we cannot satisfactorily determine whether the two species intergrade or not. Agassiz and Macoun only, have collected around Lake Superior the specimens which agree with *O. fastigiatum*, and all other American specimens which I have seen seem to be *O. affine*. However, a comparison with descriptions of European specimens show that the main characters are constant.

ORTHOTRICHUM SORDIDUM, S. & L. in Austin's Musci App. 168 (1870).

Sullivant, Icones Supplement, 67, t. 49 (1874).

This species comes very close to *O. fastigiatum*, as described by Limpricht, agreeing with it in the trabeculate and striolate teeth. The form given by Sullivant (l. c. fig. 10) is seen occasionally, but the teeth are as often trabeculate at apex, as figured by Limpricht, even in James' own specimens from Cambridge, Mass., which are the ones referred to by Sullivant in the Icones. My experience is, that in the older capsules the delicate trabeculate apex of the teeth is broken off, and they appear as figured in the Icones, though I have seen on one capsule teeth of both kinds. Limpricht makes a point in the position of the stomata to distinguish *O. fastigiatum*, stating that they are few around the base of the spore-sac, whereas in *O. affine* he says they occur in two rows around the middle of the theca. I find in *O. sordidum* that they are usually median as in *O. affine*, but I have seen them both in one row and two. The cilia in *O. sordidum* seem always regular, not appendiculate. The capsule is more immersed and more regularly ovoid when mature, before it becomes sulcate, and the neck is shorter and more suddenly contracted, and almost always immersed and invisible in *O. sordidum*, while in American specimens of *O. fastigiatum*, collected at Lake Superior, by Macoun, the neck is almost entirely exserted. I do not understand why Venturi refers *O. sordidum* to the section of *O. arcticum*, as its alliance seems to me to be entirely with the species with which I have compared it, and its range is from Closter, N. J., almost at sea level to Kent county, New Brunswick, though it has been collected at Dixville Notch, N. H., by T. P. James; the original station being at Cambridge, Mass. The leaves also have the nodose, or porose lower cells, which are specially described by Limpricht in *O. affine* and *O. fastigiatum*. *O. sordidum*, though, seems to be more allied to *O. affine* in its leaves, for the lower cells have thickened walls, the ends in some cases projecting into papillæ, bringing two adjacent ends together so that the papillæ appear double; this gives this species a very characteristic appearance, which I have not observed in either of the others, as the base of the leaves is usually smooth and free from papillæ,

though I think the amount of thickening of the basal cells depends on their position, the upper ones from the same plants being quite hyaline and smooth at base, with thin walls. Even the shape of the cells is variable, for they may be oblong and parallel with the vein, or they may be rhomboidal and oblique.

In reply to a recent letter of mine, Dr. Venturi says, concerning *O. sordidum*, that "the group of *O. affine* differs from that of *O. arcticum* only in the position and form of the papillæ on the surface of the teeth. These, like *O. affine*, have the papillæ more dispersed and irregular and occasionally truncate and reduced to intersecting lines, whereas in the group of *O. arcticum* the papillæ are smaller, more dense, and distinctly elevated. *O. sordidum* has the papillæ corresponding to the group of *O. arcticum*, not only in your specimen, but in all the others which I have examined. That would not prevent it, however, from being otherwise closely allied to *O. affine*."

ORTHOTRICHIUM LYELLII, Hook. & Tayl. Musc. Brit. i. 29 t. 22 (1818).

*O. papillosum*, Hpe. Linnæa, xiv. 458 (1860).

*O. Pacificum*, Hpe. ms. in Herb. Brit. Museum.

*O. Sullivantii*, Bauer; Austin in Bull. Torr. Bot. Club, vi. 343 (1879) (?).

*O. Pringlei*, Müller, Bull. Torr. Bot. Club, xiii. 121 (1886).

*O. strictum*, Vent. (sub-species nova) Bot. Cent. xliv. 419 (1890).

Such is the published synomymy of this species. Several times it has excited my curiosity, and the following notes and comparisons have been made. Two authentic specimens of *O. Lyellii* collected by Greville in Scotland, in Dr. Torrey's Herbarium are dark green plants with the leaves erect or secund, not crisped, though occasionally recurved or subsquarrose. They are plentifully sprinkled with brown propagula, and are distinctly papillose on both surfaces, or, as Braithwaite describes it, "with prominent conical papillæ." He says in a foot-note that Dr. Spruce found a marked form by the Ouse, near York, in 1843, with rigid closely appressed leaves.

*O. papillosum*, Hpe. l. c. (*O. Lyellii*, var. S. & L. Musci Bor. Am. Ed. ii. no. 185 (1865).)

*O. Lyellii* var. *papillosum*, Hpe.; L. & J. Man. 178 (1884).

"Leaves more highly papillose."

As the description given by the Manuel seems very meagre. Hampe's original is quoted:—Laxe cespitosum, adscendens, fusco-viride. Caulis curvatis, ramulosus, inferne nudus, superne planiuscula, foliis oblonga-lanceolata, cellulis alaribus subquadrato-angulatis, hyalinis, superne dense seriatis, elliptico-rotundis, inconspicuis, pagina folii papillis prominentibus scabra, nervo carinato, apice desinente. Theca sessilis, elliptica, leviter striata; peristomia simplici. In Mont. Sierra Nevada, Californiæ. ad saxa? (Bauer). Adnot. Specimini manca, tame species memorabilis foliis secundis. O. Texana, Sull. affine? We have seen the type of this species at the British Museum, and compared it with the specimens distributed by Sullivant & Lesquereux as no. 185 (l. c). The type and a portion of no. 185 agree in the dark green color of the plants, the erect, appressed, strongly papillose leaves, without any propagula. The greater portion of no. 185, however, in our set has the leaves squarrose, the stems more flexuose and the capsules more conspicuously exserted, approaching *O. Pringlei*, though the color is darker.

*O. Pacificum*, Hpe.; ms. was collected in 1862 by Bauer on granite rocks near San Francisco on the shore of the ocean. The plants are dark green, 6 cm. long, rigid, with appressed leaves and little fruit. The calyptras are immersed and hairy, the old capsules exserted on short pedicels and the lids are gone. It does not differ from *O. papillosum* sufficiently to be a species.

In Sullivant's herbarium I found the following note:

"*O. Lyellii* shows a most wonderful disposition to vary according to place of growth. The Californian and Oregon specimens differ only from the European in having longer, narrower leaves, more crisped and undulate on the margins when dry, and scarcely ever having on their surface the articulated glands (conferva orthotrichi). In nothing else is any difference perceptible." (Examined several times carefully.—W. S. S., Oct., 1856).

In the original description of *O. Lyellii* (Musc. Brit., p. 130), the leaves are described as follows: "On various parts of their surface the conferva orthotrichi grows in abundance, so that they appear strewn with a brown powdery substance."

I also have examined all the American specimens in our herbarium and many European; and the latter always differ from the former in the abundance of the propagula, as well as in being less crisped. All the American specimens at Kew are without propagula.

*O. Sullivantii*, Bauer, is referred to by Austin in the BULLETIN (l. c.) as "growing on trees, having the peristome reflexed when dry and the leaves of a different texture from *O. Hainesiæ*," but I can find no reference to it elsewhere. I have seen the specimens collected by Bauer, and they also have no filaments, and are probably *O. papillosum*, Hpe.

*Orthotrichum Pringlei*, C. Müller (l. c.)

Pringle's types were collected at Winchester Bay and Coos River, Oregon, and are remarkable for the light yellowish green color and flexuose branches, as well as for the curly leaves. Fine specimens have also been sent to us by Thomas Howell, from Yaquima Bay, in mats six inches across, unmixed with any other species. At first sight, it would not be referred to *O. Lyellii*, and without seeing the specimens growing and intergrading I should incline to maintain this as a species. In a letter from C. Müller, to whom I sent a series of specimens, he says, July 13, 1888, "Ich melde Ihnen, dass ich jetz damit einverstanden bin, mein *Orthotrichum Pringlei* ad forma longifolia crispata papillosa *O. Lyellii* zu bringen. Hampe nannte es einmal *O. papillosum*, ein anderer mal *O. Pacificum*."

I have seen all the types of Hampe's species referred to, and he never had any specimens corresponding to *O. Pringlei*. All his were dark green and rigid. The only other localities from which *O. Pringlei* is represented in our herbarium are Vancouver Island, collected by Macoun, May 17, 1875 (203), and a few scraps collected by W. H. Shockley, at Candalaria, Nevada, and part of S. & L. Musci Bor. Am. number 185, which also has flexuose branches, though the color is darker green, collected by Bolander in California. All the other specimens collected in California by Bolander, Watson and M. A. Howe are dark and rigid. J. B. Leiberg's specimens from near Lake Pend d'Oreille, Idaho, are bright green and stiff, and this is the easternmost locality represented in our herbarium.

*Orthotrichum strictum*, Vent., is described as a "subspecies of *O. Lyellii*, without propagula, and the leaves lanceolate and straight, the capsules short stalked, otherwise as in *O. Lyellii*."

I have not seen Roll's specimens, but from the description I see no differences sufficient for making a new sub-species when we have already several synonyms abundantly defined. I am not a believer in sub-species either, and question whether this is not *O. papillosum*, Hpe.

Renauld and Cardot, in their check-list of North American mosses, maintain four species, Nos. 543–546. Probably only two of these will stand, *O. papillosum* and *O. Pringlei*.

A large suite of European specimens of *O. Lyellii* from the Jaeger Herbarium shows none approaching *O. Pringlei* in the general aspect of its curly leaves and flexuose branches.

ORTHOTRICHUM DOUGLASII, Duby. Mem. Soc. Phys. d'Hist. Nat. de Geneve, xix. 293, t. I. fig. 2 (1868).

Through the kindness of M. Barbey and M. Eugene Autran, of the Boissier Herbarium, I have seen the type of this species in Duby's herbarium, collected by Douglas on the Columbia River, in 1830. In comparing the specimens with the description, l. c., I find one discrepancy. The description reads as follows: "theca erecta cylindrica sub ore parum dilatata fuscescente ecostata basi subplicata." The capsules are not *ecostate*, for the walls show eight yellow bands of three or four rows of thickened cells, forming short ridges when the capsules are old and dry. The stomata are small and superficial, usually one at the termination of each band, in the middle of the theca, not around the base of the spore-sac; the surrounding cells are not much modified nor radiating. The following measurements may be of service in identifying the species, which has not been collected since it was described: Seta 2 mm. long, vaginule 1 mm. long, theca 2.5 mm. long and 1.33 mm. broad, the neck defluent into the seta, exserted beyond the perichætial leaves, which are 2–3 mm. long, 1 mm. broad, with a blunt apex, hyaline concave base, without a revolute margin. They almost entirely cover the seta. There are but a few capsules preserved; one is quite immature, with the calyptra still on, and the others are old and deoperculate, but Duby kept in a mica slide, mounted in balsam, the peristome from which the figures

were drawn. Figure b. represents the teeth shorter, and with fewer segments than the original; they are erect when dry. The mouth is bordered by several rows of smaller cells, and there is a hyaline annulus. Figure d. also is poor, because the type has the neck defluent, and figure f. because the calyptra is lobed, distinctly striate, and is not nearly as wide as represented, its base clinging close to the base of the capsule, which, however, is immature. I compared the specimens with *O. Texanum*, number 187 of S. & L. Musci Bor. Am., ed. II., 1865, and with the plate of the latter in the Icones. The leaves are very similar, being carinate, with strongly revolute margins, the apex acute, and often plane for a short distance above the point where the vein disappears, or the vein may be percurrent. The base of the leaf in *O. Texanum* is narrower and more decurrent at the angles, and the margins are revolute to the base; the vein is broad and thick, often brown, and the basal cells are yellow, oblong or sinuous.

It seems probable that *O. Douglasii* must be masquerading under another name in our herbaria, but owing to the imperfect condition of the type, it would be difficult to prove this.

ORTHOTRICHUM KINGIANUM, Lesq. Mem. Cal. Acad. i. 18 (1868), Sull. Icon. Musc. Suppl. 74, t. 55 (1874).

When studying the mosses collected by J. B. Leiberg, I was permitted by Dr. Watson to examine the type of this species, which has only been collected once, by Bolander at the Falls of the Yosemite. It is closely allied to *O. lævigatum*, Zett., and the similarity will be apparent if the figures of both are compared. *O. lævigatum* is described as a variable species by Venturi, and is much more common in America than the Manual would indicate, as it cites only one locality in Western Nevada (Watson). Our specimens from this locality, No. 1404 Watson, are not this species but seem to be *O. Watsoni*. Macoun collected *O. lævigatum* at the Cascades at Yale in 1875, and Austin described it as *O. Macounii*, n. sp. (BULLETIN, vi. 343, 1879), but subsequently referred it to *O. Kingianum*. It has recently been distributed in Macoun's Canadian mosses as No. 454, and has been collected in two localities near Lake Pend d'Oreille by Leiberg, showing mixed with it forms with a broader pyriform capsule and shorter seta, as in *O. Kingianum*. More study and material is desirable of these four species.

B. Those with immersed stomata.

ORTHOTRICHUM ANOMALUM, Hedw. Musc. Frond. II. 192, t. 37 (1788).

I have not seen the type of this species, but it would be desirable to know whether it has the teeth united in pairs, and whether the cilia are present, as Limpricht maintains *O. saxatile*, Brid., on these characters. Braithwaite recognizes it only as *O. anomalum*, var. *cylindricum*, Sch., claiming that though Bridel's name is the older it should be rejected because it was used to include both *O. anomalum* and *O. saxatile*, forgetting that according to the Paris code the enlargement or restriction of a species does not warrant a change of name. Venturi also considers it only a variety of *O. anomalum*, but calls it var. *saxatile*.

We have found that No. 177 S. & L. Musci bor. Am., Ed. II., distributed as *O. anomalum*, agrees with the description of *O. saxatile* given by Limpricht, in having the teeth united in pairs, and eight cilia alternating with them; also the ridges of the capsule are only 8, with occasionally only a trace of the intermediate ones; the capsules are much exserted, cylindric, and longer than in *O. anomalum*. The leaves also have the walls of the lower cells thickened nodosely, and the perichætial leaves are 4 mm. long. The specimens were collected at Niagara Falls, and we have not seen this species from any other locality, though it may be looked for among those labelled *O. anomalum*, and has probably been mistaken for that species.

ORTHOTRICHUM CUPULATUM, Hoff. Deutsch. fl. ii. 26 (1796).

*O. strangulatum*, P. Beauv. Prod. 81 (1805), fide Braithwaite.

*O. strangulatum*, Schwaegr. Suppl. I. ii. 53, t. 34 (1816).

I have not verified the synonymy of this species, though the types are probably at Geneva. *O. strangulatum*, Sull., of the Manual, however, is doubly debarred, as Venturi says it is the same as *O. Braunii*, Br. & Sch. As is well-known, *O. cupulatum* forms a marked group of closely allied forms or species, and hence has been variously treated by different authors. Braithwaite describes it as a polymorphous species with one variety, *nudum* (*O. nudum*, Dicks). Venturi recognizes *O. nudum* as a species, besides separating off *O. urnigerum*, Myrin, *O. Sardagna-*

*num*, Vent., and *O. Venturii*, DeNot. Limpricht recognizes six species in the Laubmoose, and Austin separated off *O. Porteri*, *O. Peckii* and *O. Lescurii*, the last of which was figured in Sullivant's Supplement to the Icones as var. *minus*, and referred with the other two to *O. cupulatum* as varieties.

Recently, in studying the genus, I came to the conclusion that Austin's view was more in accordance with modern methods, and seeing that Dr. Venturi had not seen specimens of Austin's species, I sent him authenticated specimens asking him for his opinion. In a letter dated the 11th of September, he says:

"I have at present at my disposal a set of Austin's Musci Appalachiani, and I find that the specimens of *O. Lescurii* and *O. Porteri* agree with those you have recently sent me and with the observations made in your letter. I find, however, in the packet containing *O. Porteri* another label belonging to *O. Peckii*, and being unable to distinguish the two forms, which perhaps are mixed in my specimen, I cited them as synonymns in the Muscologia Gallica. Recently, with the aid of your specimens, I have obtained a more positive notion of the characters of *O. Porteri*, which is not found in Europe. I am however still in doubt about *O. Peckii*, of which I have a morsel sent me by Lindberg from his set of the Musci Appalachiani. It may be that *O. Peckii* is simply a variety of *O. cupulatum*, but *O. Porteri* is in my opinion much more than a variety. The idea of a species is and always will be subjective and changeable according to the views of different authors. Now-a-days, when species are shaken and pulverized, as for example, *O. pallens* in Limpricht's Laubmoose, and *O. nudum* and *O. Sardagnanum* rank with *O. cupulatum*, we cannot without contradiction refuse to recognize *O. Porteri*. It is true that it has a distinct preperistome, but without the diagonal striations; and the teeth besides the longitudinal lines have their outer surface papillose. Of more importance and more conclusive in my opinion, is the elongated form of the capsule, which is occasionally almost cylindric, and the color of the ridges of the pericarp being an orange red instead of yellow. In several particulars *O. Porteri* is intermediate between *O. cupulatum* and *O. anomalum*, having the short truncate base of the capsule as in the former and the ovate-cylindric form and color of the capsule of the latter. Besides

the hairs of the calyptra in *O. Porteri* are distinctly papillose and composed of 3–4 series of cells, whereas those of *O. anomalum*, if they exist at all, are almost simple. With *O. nudum* and *O. Sardagnanum*, it has no resemblance, as their distinctive character is the defluent neck of the capsule. I shall, therefore, uphold the autonomy of *O. Porteri*, leaving solely *O. Peckii* as a variêty of *O. cupulatum*, as I have modified my opinion since I wrote the monograph for M. Husnot.

As for *O. Lescurii*, that also is in my opinion, an excellent species, even though the very small capsules have the form of the capsule of *O. cupulatum ;* for the ridges are always eight in *O. Lescurii*, and the peristome is papillose and without a preperistome, besides all the other characters which determine a species."

I do not agree with Dr. Venturi in referring *O. Peckii* as a variety to *O. cupulatum*, for it has only eight ridges to the capsule, which is also elongated as in *O. Porteri*, and it is to the latter species which it should be referred as a synonym, to which position Austin consigned it in his herbarium and in the BULLETIN (vi. 341, 1879).

ORTHOTRICHUM BRACHYTRICHUM, Schimper.

*O. brachytrichum*, Sch.; L. & J. Proc. Am. Acad. xiv. 140 (1879).

Drummonds Musci Americani, 157 pp. with *O. obtusifolium*.

Austin, Bull. Torr. Bot. Club, vii. 8 (1880). Macoun's Cat. 90 (1892).

We have been favored with a portion of the type of this species from Kew, and have also seen four sets of Drummond's mosses Dr. Torrey's, Sullivant's and those belonging to the Academy of Natural Sciences of Philadelphia, and the Geological Survey of Canada at Ottawa. In all except Sullivant's the specimens are all *O. obtusifolium*, but in his set they are mixed with *O. brachytrichum*. The type of the latter, though much resembling the former in its erect-appresssed leaves, bearing septate propagula, has the leaves acuminate, not obtuse, at apex, often erose or denticulate, occasionally cuspidate and hyaline like *O. diaphanum;* the margins are revolute and the cells faintly protuberant, not papillose; the stomata are immersed, not superficial, and the calyptra sparsely hairy. It differs from *O. diaphanum* in having only eight cilia, and the teeth are united in pairs (4-parted), not single.

In Austin's herbarium there is an autograph specimen from James, which is probably the one referred to in the BULLETIN (l. c.), labelled *O. obtusifolium*, Drummond's No. 157, on which Austin has written: "equals *O. brachytrichum*, Sch., of course it is *O. obtusifolium*," as undoubtedly it is, James having sent him only a part of Drummond's 157, and not the same as that he sent Schimper. The specimen of *O. obtusifolium* collected by Austin in Jordansville Swamp, New York, 1868, above referred to, has both acute and obtuse leaves on the same plants. These helped him, also, to confuse the two species.

## Unequal Segmentation and Its Significance in the Primary Division of the Embryo of Ferns.

BY GEO. F. ATKINSON.

In studying the embryos of several species of the Polypodiaceæ, sections were obtained of the primary division which suggested the possibility of some fundamental law governing unequal segmentation of the egg, in some species at least. In finishing a camera lucida sketch of an embryo of *Pteris serrulata* I noted what at first was not observed, the two cells with their nuclei were of unequal size. Thinking some error might have arisen in connection with the first sketch the preparation was examined again, when it was easy to note the smaller size of the nucleus in the smaller anterior segment. Measurements with the micrometer showed that the diameter of the nucleus in the posterior segment was one-fourth to one-fifth greater than that of the anterior segment.

If this state of things were reasonably constant it would show a definite relation existing between the primary segmentation and the different functions of the two segments. That is to say, the nucleus of the egg first divides into two unequal nuclei, an anterior one smaller than a posterior one; that these unequal nuclei govern the size of the two primary segments of the embryo by which that part of the plant chiefly concerned in supplying nutriment, the root segment, is differentiated from that part chiefly

concerned in the reproductive function, the stem segment. This is important from the fact that at the start the embryo is wholly dependent upon the prothallium for its nutriment.

The posterior segment, being the larger, presents a much greater absorbent surface over the prothallial tissue, and by subsequent growth and cell division more quickly reaches the extended surface characteristic of the foot in the early stage of the embryo.

For some time in the later divisions of the embryo, the tissue derived from the posterior segment exceeds in bulk that derived from the anterior segment. This is recognized as bearing a definite relation to the function of the different parts of the embryo. Why should not the impulse to this rational differentiation in the young tissues of the embryo exist in the egg and be manifested in the primary unequal division as seen in this example of *Pteris serrulata?* Another case was found in the embryo of *Adiantum cuneatum;* the anterior segment with its nucleus was smaller than that of the posterior segment. Goebel, Outlines of Classification and Special Morphology of Plants, p. 204, figures an embryo of *Adiantum Capillus-veneris* showing the anterior segment much smaller than the posterior segment. The nuclei are not shown, and he gives no explanation of the unequal size of the two segments. If the section were not perpendicular to the first division-wall, but oblique to it, the size of the cells might vary according to the focus plane of the microscope or the position of the section in the embryo. In the specimens of *Pteris serrulata* and *Adiantum cuneatum*, referred to above, it was especially noted that the primary division wall was perpendicular to the section. This added to the fact that the nuclei were unequal in size is conclusive that the stem segment was smaller than the root segment.

A few cases only would not be sufficient evidence to warrant the assumption that a general law of this nature exists, but it seems to me that it is sufficiently strong to warrant an enquiry as to its significance. It is desirable that an examination be made of a number of embryos showing the primary division, with a view to see how far this unequal segmentation will hold good. The fact that in the Polypodiaceæ the foot is much more highly devel-

oped than in the lower orders of ferns would seem to favor the possibility of there being a primary unequal segmentation of the embryo.

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## Two Perfectly Developed Embryos on a single Prothallium of Adiantum cuneatum.

BY GEO. F. ATKINSON.

It is well known that several archegonia on a single prothallium of the ferns may possess fertilized eggs. In some cases more than one of them is known to begin embryological development, but it is quite rare that more than one becomes a perfectly developed embryo capable of forming an independent plant. The statement is sometimes made that while several archegonia may possess fertilized eggs never more than one embryo is perfectly developed.

Heinricher,* in lighting prothallia both above and below, succeeded in causing the development of archegonia in numbers on both surfaces. In two cases two archegonia possessed fertilized eggs which developed into perfect embryos, one each above and below. This might be considered an abnormal condition induced from the peculiar condition of lighting.

Rauwenhoff† notes the development of two embryos on single prothallia of *Gleichenia*. In both of these cases, however, we are not informed of the comparative strength or advanced condition of growth of the embryos, so that it may be an open question whether both of the embryos on a single prothallium could have developed into independent plants.

Campbell‡ also observes two embryos on a single prothallium of Osmunda, but states that one was far in advance of the other, and would probably have starved it out before the two could obtain foothold in the soil.

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* Heinricher, Beeinnflusst das licht die Organ Auflage am Farn Embryos, Mitt heilungen des bot. Inst. zu Graz, Heft II., pp. 239–253.

† Rauwenhoff, De geslechtsgeneratie der Gleicheniaceen. Verh. d. Koninkl. Akad. van Wetensch. t. Amsterdam, 1889.

‡ Campbell, On the Prothallium and Embryo of *Osmunda Claytoniana* and O. *cinnamomea*, Ann. Bot. vi., 1892, 49–94.

In my studies of several species of the Polypodiaceæ I observed a prothallium of *Adiantum cuneatum* which showed two well developed cotyledons of apparently about the same age, and growing parallel to each other. Examining the specimen carefully it was noted that both cotyledons were attached to the under surface of the prothallium side by side, and that by the base of each was a young leaf the tip of which was rolled up in circinate fashion. Two well developed roots also issued side by side a little to the rear of the cotyledons. The roots were long and well fastened to the substratum. These parts gave every appearance of there being two perfectly developed embryos that were in fact two independent plants from the same prothallium. A sketch was made of the prothallium with its two plants. It occurred to me that possibly this apparent development of two perfect embryos side by side on a single prothallium might be some abnormal condition of a single embryo in which the stem and root, or possibly the stem and root segment, had forked at a very early period in its developement. To be certain what the real condition of things was, the bulk of the cotyledons and roots was cut away and the prothallium with the young plants attached was cut in serial sections and mounted for examination. The sections were cut parallel with the axis of the prothallium and thus parallel with the embryo. From the point of passing in at one embryo to the issuing from the other all the sections were saved and arranged serially. A study showed two separate and perfect embryos, and they were so far advanced as to be able to exist independent of the prothallium.

BOTANICAL DEPARTMENT,
CORNELL UNIVERSITY.

## Botanical Notes.

*Blephilia ciliata* (*L.*) *Raf., in Western New York.*—On July 2, 1893, I found a small tract of plants of *Blephilia ciliata* (L.) Raf., near Canandaigua, N. Y. The specimens grew in a low, rocky pasture adjoining a swamp. The plants were fine, being in full bloom at that time.

As nearly as I have been able to ascertain, *Blephilia ciliata* is

one of the rare plants of New York. The range of Gray's Manual, Massachusetts to Minnesota, to be sure includes New York, but specific instances of its occurrence in the State are not forthcoming. It is not included in Dr. Torroy's Flora of New York, neither is it catalogued in Paine's "Plants of Oneida County and Vicinity," in the "Cayuga Flora," nor in the "Plants of Buffalo and Vicinity." Mr. David F. Day writes, that until the present instance, he never had heard of it as occurring in this State. It is mentioned in the preliminary catalogue of plants growing within one hundred miles of New York City, but the locality is not stated. Unless this last citation be based on a New York locality, I believe that the present is the first recorded instance of the occurrence of the species in New York State.

ELIAS T. DURAND.

ITHACA, N. Y.

*Insular Vegetation.*—To the list of plants seen in a very hasty visit made in 1885 to Great or South Duck Island, on the coast of Maine, published in the BULLETIN, xii. 103, I can now add the following species, seen in 1893:

Ranunculus acris, L.,
*Arenaria lateriflora*, L.,
Cerastium arvense, L.,
*Montia fontana*, L.,
*Impatiens pallida*, Nutt.,
Trifolium repens, L.,
*Rubus strigosus*, L.,
*Potentilla Anserina*, L.,
*Drosera rotundifolia*, L.,
*Ligusticum Scoticum*, L.,
*Epilobium lineare*, Muhl.,
*Cornus Canadensis*, L.,
*Linnæa borealis*, L.,
*Galium trifidum*, L. var. *pusillum*, Gray.,
*Solidago* ——— (immature),
*Aster Radula*, Ait.,
*Prenanthes alba*, L.,
*Vaccinium macrocarpon*, Ait.,
*Menyanthes trifoliata*, L.,
Veronica peregrina, L.,
*Plantago decipiens*, Barn.,
Polygonum aviculare, L.,
*Myrica Gale*, L.,
*Sisyrinchium angustifolium*, Mill.,
*Smilacina trifolia* (L.) Desf.,
*Triglochin maritima*, L.,
*Ruppia maritima*, L.,
*Juncus Balticus*, Deth. var. *littoralis*, Eng.,
*Juncus bufonius*, L.,
*Juncus pelocarpus*, E. Mey.,
*Eleocharis* ———
*Scirpus maritimus*, L.,
Festuca ———.

The species in Roman may be considered recent introductions. *Cerastium arvense*, L., was noticed many years ago by Mr. Edward L. Rand, upon the sheep-fed part of the island. *Cerastium viscosum* of the earlier list would now be called *C. vulgatum*, and

the *Epilobium coloratum* of that list is now generally referred to E. *adenocaulon*, Haussk. The present list is probably not complete.

JOHN H. REDFIELD.

*Montia fontana*, L.—This diminutive Portulaceous plant, though widely distributed in the colder and temperate regions of both hemispheres, has not hitherto been noticed within the limits of our Atlantic States. It has been seen near Halifax, Nova Scotia, and Shediac, New Brunswick, and thence northerly.

On the 5th of July last it was detected by Mr. Edward L. Rand, near the eastern shore of Great Cranberry island, two miles south of Mt. Desert, Maine. Fresh from the study of Mr. Rand's specimens, I found it on the 17th of the same month, at two localities upon South Duck island, ten miles south of Mt. Desert. Careful search will doubtless reveal other localities on the Maine coast.

JOHN H. REDFIELD.

*Su Alcune Briofite Fossili.* U. Brizi (Bull. Soc. Bot. Ital. ii. 369–373, 1893). A list is given of twenty-four species of mosses, of which eighteen are still living near Rome; two are new, *Rhynchostegium orthophyllum* and *Dicranum Clericii.* From the variety of habitats of the different species, the author concludes that they must have collected in some slow stream and been imbedded there. They are so well preserved that even the cell structure of the leaves is visible. E. G. B.

*Solanum elæagnifolium, forma albiflorum.*—Corolla white. I found six or seven plants of this pretty form at El Paso, Texas, growing close together—probably seedlings from one plant. The ordinary form of the species was abundant close by, but not mixed with the white-flowered ones. The color of the corolla in *Solanum* is well known to vary from violet or purple to white (as in the common potato), but it is interesting to notice how the white corolla may become a specific character (as in *S. nigrum*), in which case it rarely varies to purple. *S. nigrum* is one of the commonest plants in England, and I never saw one with the flowers other than white; yet Coulter (Bot. Rocky Mtn. Reg. p. 268) refers to a bluish form. Similarly, *S. triflorum*, which I found commonly in Colorado, had always white flowers in my

experience, though in Rep. U. S. Dep. Agric. for 1888 it is said to have the flowers "white or pale blue."

T. D. A. COCKERELL.

LAS CRUCES, N. MEX. Aug. 27, 1893.

## Reviews of Foreign Literature.

*An Introduction to the Study of the Diatomaceæ.* By Frederick Wm. Mills, F. R. M. S., author of Photography applied to the Microscope, with a Bibliography by Julian Deby, F. R. M. S. (London, Iliffe & Son, 3 St. Bede St., Ludgate Circus. Washington, D. C.: The Microscopical Publishing Co., 1893.)

This beautifully printed book is somewhat of a disappointment to the reviewer, and were it not for the extensive bibliography it would be a "twice told tale," and to us not as well told as it could have been. True it is, that in an "Introduction" an author is not supposed to write a monograph upon the subject, yet we feel that the description of what diatoms are, their habitats and their physiological properties is told in a very cursory manner, and hardly full enough for the beginner to get a real knowledge of the plants. We much prefer other articles upon the subject, both for logical arrangement, completeness and lucidity.

The individual chapters upon Structure, Modes of Reproduction, Collecting and Mounting are too brief, and we cannot but feel that the "Introduction" compares very unfavorably with the "Bibliography," which of itself makes the book of paramount value; such a book that no worker in the diatoms can get along without, and one that will prove of inestimable stimulation to the amateur.*

The paper, printing and binding are especially commendable, and the book is well worth the price asked for it. S. E. J.

## Index to Recent Literature Relating to American Botany.

*Additions to the Preliminary List of the Uredineæ of Ohio.* Freda Detmers (Bull. Ohio Agric. Ex. Sta. i. 171).

* We note, however, many gaps in this Bibliography, especially in the numerous papers of the later years.

*Æchmæa Henningsiana, Wittm. und Bilbergia Schimperiana Wittm.* Fritz Müller (Ber. deutsch. Bot. Gesell. xi. 364–366).

*Agave Antillarum, Desc.* O. G. Petersen (Bot. Tidssk. xviii. 266–270; one plate).

*Analytical Synopsis of the Groups of Fungi.* W. A. Kellerman and Aug. D. Selby (Bull. Ohio Agric. Ex. Sta. i. 203).

*Anatomie der Acanthaceengattungen Afromendoncia und Mendoncia.* E. Gilg. (Ber. deutsch. Bot. Gesell. xi. 351–364; one plate.)

*Aphyllon uniflorum at London, Ont.* J. Alston Moffat (Ott. Nat. vii. 99).

*A Reader in Botany. Part II. Flower and Fruit. Selected and adapted from well-known authors by Jane H. Newell* (Boston, Ginn & Co., 1893, 179 pages, illustrated. Price sixty cents.

As in all her other books, Miss Newell has succeeded in making a very attractive little volume, without sacrificing scientific accuracy or methods. In fact we venture to think that some of the statements quoted from Miss Buckley's Short History of Natural Science would have been better made by the author, or omitted.

To those who have not had the time nor patience to study Darwin's and Müller's work on the Fertilization of Flowers by insects, and are not acquainted with Sprengel's, these chapters will serve as a pleasant introduction, and prove an incentive to further observation and study. The illustrations are all good, and the scientific names are given in nearly all cases.

*Bacillus of Cheese—An Aromatic.* L. H. Pammel (Iowa Agric. Coll. Ex. Sta., Bull. No. 12, 792).

*Bacillus aromaticus*, n. sp. is described and figured.

*Bibliography of Ohio Botany.* W. A. Kellerman (Bull. Ohio Agric. Ex. Sta. i. 180).

*Botany at the World's Fair.* J. C. Arthur (Bot. Gaz. xviii. 357–364).

*Botanical Notes from Texas.* E. N. Plank (Gard. and For. vi. 392).

*California Flora—Southern Extension of.* T. S. Brandegee (Zoë, iv. 199, reprint).

New plants described are *Lupinus pallidus* and *Madia valida*. *Perityle rotundifolia* (Benth.) is concluded to be the rightful name of the plant that has been variously known as *Amauria rotundi-*

*folia*, Benth., *Perityle Fitchii*, Torr., and *Laphamia peninsularis*, Greene.

*Californian Herb-lore—I.* Ida M. Blochman (Erythea, i. 190, 191).

Notes on *Perezia microcephala* and *Trichostema lanatum*.

*Carex flava, L. og Carex Œderi, Ehrh.* O. Gelert (Bot. Tidssk. xviii. 271, 272).

*Contributions a la Flore du Paraguay—Piperacees.* C. De Candolle (Mem. Soc. Phys. Hist. Nat. Genéve, xxxii. No. 2).

Eight species of the genus *Piper* are enumerated, of which *P. cinerascens* and *P. fulvescens* are new. Nine species of the genus *Peperomia* are described, one of which *P. psilostachya*, is new. Plates are given of the new species.

*Distribution of some Forest-trees in the Southern States—The.* Chas. Mohr (Gard. and For. vi. 372).

Notes on *Hicoria myristicæformis*, *H. Pecan* and *Quercus Durandi*.

*Distribution of some Western Plants—On the.—I.* Edw. L. Greene (Erythea, i. 181–184).

Notes on species of *Lepidium*, *Matricaria discoidea* and *Madia sativa*.

*Early scientific Expeditions to California—I.* Willis L. Jepson (Erythea, i. 185–190).

Mr. Jepson has here given us a valuable and readable account of the first scientific expedition which visited California—that of the French explorer, La Peyrouse, who touched at Monterey with two frigates in 1786, five years before the visit of the Spanish explorer, Malaspina, with whom came the botanists Hænke and Nee.

*Erythræa Centaurium.* C. J. S. Bethune (Ott. Nat. vii. 99).

Record of its occurrence at Roach's Point, Lake Simcoe, Ont.

*Evolution and Classification.* Chas. E. Bessey (Bot. Gaz. xviii. 329–333).

Abstract of Vice-Presidential address before the Section of Botany, A. A. A. S., Madison meeting, August, 1893.

*Examination of Glyptodendron, Claypole, and of other so-called Silurian Land Plants from Ohio.* Aug. F. Foerste (Am. Geol. xii. 133–141, Pl. VII.).

An analysis of the species *Glyptodendron Eatonense*, Claypole,

originally thought to be a plant and described as such. Comparison with other similar specimens has convinced the author that it is not a plant but a cephalopod, he therefore places this and *G. subcompressum*, Beecher, in the sub-genus *Glyptodendron*, and takes them out of botany into the cephalopod genus *Cyrtoceros*.

He also expresses the opinion that other supposed land plants of the Cincinnati group, viz: *Protostigma sigillarioides*, *Psilophytum gracillinum* and *Sphenophyllum primævum*, described by Lesquereux, are not such. The first may be a fucoid, the second probably a *Dendrograptus*, and the third probably some inorganic marking. A. H.

*Flora of Madison and Vicinity; a preliminary Paper on the Flora of Dane County, Wisconsin.* L. S. Cheney and R. H. True (Trans. Wisc. Acad. ix. 45–135; reprinted).

This is an interesting list of 900 species of plants, with localities and habitats, observed and collected mainly by the authors. A feature of the work is the indication of the officinal and non-officinal medicinal species. Specimens illustrating the catalogue have been deposited in the herbarium of the University of Wisconsin.

*Flora of Ohio—New Plants for the.* Wm. C. Werner (Bull. Ohio Agric. Ex. Sta. i. 235).

*Flora of the Bouldin Island.* Katharine Brandegee (Zoë, iv. 211, reprint).

*Flora of the Niagara Peninsula and Shores of Lake Erie—Notes on the.* John Macoun (Journ. and Proc. Hamilton Ass. ix. 78).

Two species new to Canada are noted, *Hemicarpha subsquarrosa* and *Fimbristylis capillaris*.

*Flowering Plants of Jamaica—A Provisional List of the Indigenous and Naturalized.* William Fawcett (Kingston, 1893).

*Folk-lore of Plants—The.* Carrie M. Derick (Can. Rec. Sci. v. 332–339).

*Hemlock in Minnesota.* H. B. Ayres (Gard. and For. vi. 418).

*Ilex conocarpa, Reiss.* J. D. Hooker (Bot. Mag. t. 7310).

Native of Brazil.

*Krugia, eine neuer Myrtaceengattung.* I. Urban (Ber. deutsch. Bot. Gesell. xi. 375–376).

Based on *Marliera elliptica*, Griseb, from Trinidad and St. Vincent.

*Leguminosæ—The Morphology of Root-tubercles of.* Albert Schneider (Am. Nat. xxvii. 782; illustrated).

*Mamillaria rigidispina, Hildman* (Monats. Kakteenk. iii. 111–114; one figure).

*Notes on Distribution of and Stations for a few Rare and Interesting Ohio Plants.* Wm. C. Werner (Bull. Ohio Agric. Ex. Sta. i. 232.

*Notes on the Flora of Long Island.* S. E. Jelliffe (Science, xxii. 6).

The author gives a condensed account of what has been written upon the flora of Long Island, the number of species which have been identified, and calls attention to some of the most interesting ones. Reference is also made to the geological features and their probable influence upon the floral distribution.

*Nymphæa tuberosa.* (Gard. and For. vi. 415).

*Ohio Plants—Notes on rare.* Aug. D. Selby (Bull. Ohio Agric. Exper. Sta. i. 241).

*Persimmon—The.* J. T. Rothrock (Forest Leaves, iv. 72, with illustrations of *Diospyros Virginiana.*

*Philosophy of Flower Seasons—The.* Henry L. Clarke (Am. Nat. xxvii. 769).

*Plants of Ohio—New or Rare.* W. A. Kellerman (Bull. Ohio Agric. Ex. Sta. i. 241).

*Rape Plant—The.* Thomas Shaw (U. S. Depart. Agric. Farmers' Bull. No. 11). With illustrations.

*Redwood in the Oakland Hills—The.* Wm. P. Gibbons (Erythea, i. 161–166).

An account of the isolated forest of *Sequoia sempervirens*, which occurs back of San Francisco Bay.

*Rhodochiton volubile.* (Garden, xliv. 8, with colored plate.)

*Saccaromyces—The Spore-Forming Species of the Genus.* J. Christian Bay (Am. Nat. xxvii. 685, reprint).

*Scitamineæ nonnullæ novæ vel minus cognitæ.* O. G. Petersen (Bot. Tidssk. xviii. 260–265; three plates).

*Costus Friedrichsenii*, n. sp., habitat unknown, *C. Mexicanus* Liebm. ined. of Mexico and *Ischnosiphon pruinosus*, n. sp., habitat unknown, are characterized and illustrated.

*Sequoia gigantea—Native Habits of.* Gustav Eisen (Zoë, iv. 141–144).

*Sierra Nevada Plants in the Coast Range.* Katherine Brandegee (Zoë, iv. 168–176).

Record of the occurrence of 95 species and varieties.

*Solidago petiolaris* (Meehan's Month. iii. 129).

*Southwestern Plant Groups—A Characteristic.* Henry Clarke (Pop. Sci. Month. xliii. 786).

Illustrations are given of species of *Opuntia*, *Cereus*, *Yucca* and *Agave*.

*Systematic and Alphabetical Index to New Species of North American Phanerogams and Pteridophytes published in 1892.* Josephine A. Clark (Contr. U. S. Nat. Herbarium, i. 233).

*Tennessee Plants—Some new.* S. M. Bain (Asa Gray Bulletin, No. 2, 10).

Record of 18 species, additional to Dr. Gattinger's Flora of the State.

*Tipularia discolor.* H. C. Beardslee (Asa Gray Bulletin, No. 2, 11, 12).

*Tubercules d'Apios tuberosa et d'Helianthus tuberosus—Observations anatomiques sur les.* Paul Nypels (Bull. Soc. Bot. Belg. xxxi. 216–230; three plates).

*Teratological Notes.* J. Burtt Davy (Erythea, i. 192–193).

Observations on *Leptosyne gigantea*, *Agoseris hirsuta* and *Salvia Columbariæ*.

*The Violet.* O. R. Willis (New York Military Academy Quarterly, iv. 4–6; six figures).

Description of the native violets about Cornwall, N. Y.; several new forms are proposed.

*Tonina fluviatilis Aubl.* V. A. Poulsen (Bot. Tidssk. xviii. 279–292; two plates).

A morphological and anatomical study.

*Vegetable Pathology for 1892—Report of the Chief of the Division of.* B. T. Galloway (U. S. Depart. Agric., 1893, illustrated).

*Vegetation of the Summit of Mt. Diablo.* Edw. L. Greene (Erythea, i. 166–179).

A list of 156 species. *Agoseris intermedia* is described as new, and *Malvastrum Fremonti* is transferred to *Malveopsis*.

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